

Clip-On Displacement Gages
632.02/.03/.05

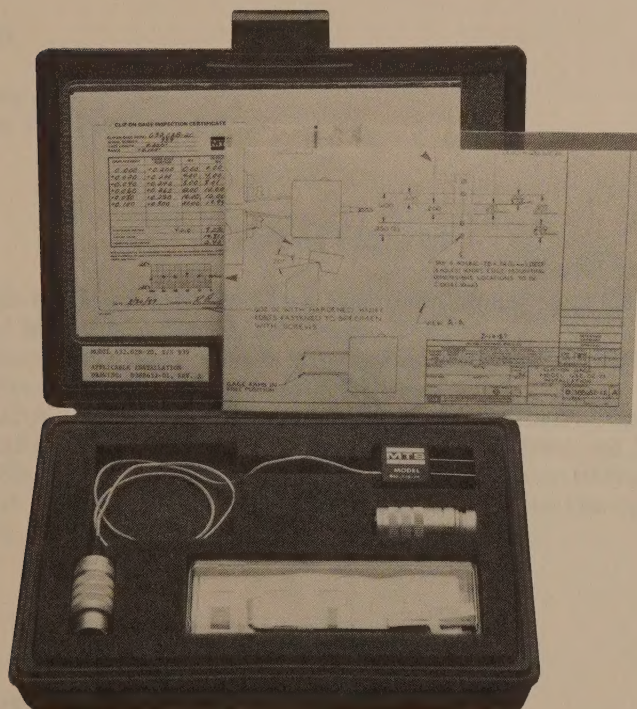


MP MASTER



MA32832

Models 632.02/.03/.05 Clip-On Displacement Gages



013-273M



MTS SYSTEMS CORPORATION

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Model 115 03.02
Chlorine Disinfection Gaps

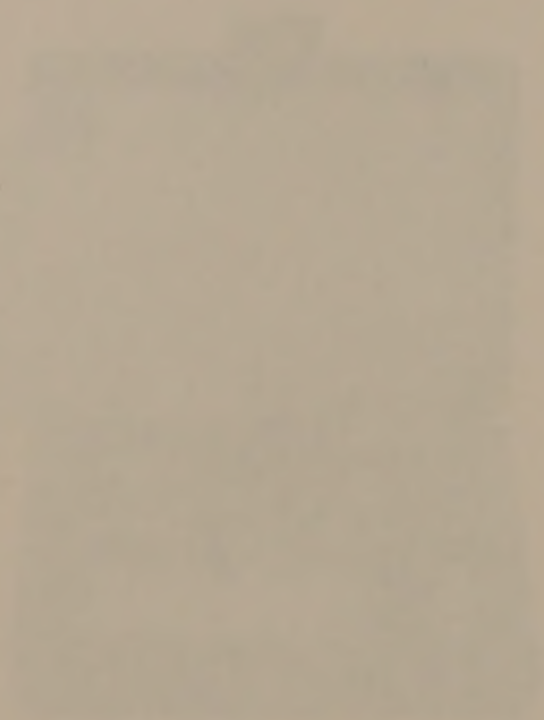


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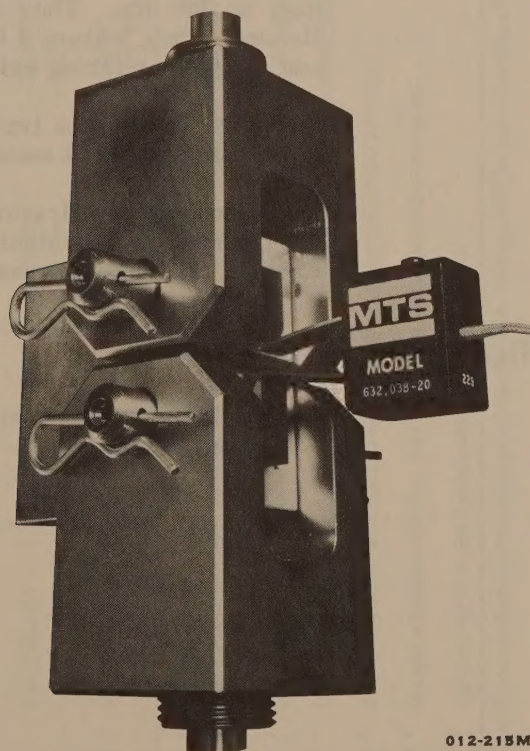
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Section I Introduction

This section contains the functional description and specifications of Models 632.02, 632.03 and 632.05 Clip-On Displacement Gages. Figure 1-1 shows a Model 632.03B-20 Gage attached to a specimen mounted in fracture mechanics grips.

1.1 Functional Description

The MTS Models 632.02, 632.03 and 632.05 Gages are double cantilever arm, displacement gages. These Clip-On gages are designed to sense crack opening displacements and are typically used to monitor crack growth in a specimen during fracture mechanics testing. They use precision, resistance-type strain gages bonded to a metallic element to form a Wheatstone bridge circuit. When installed, the spring loaded cantilever arms are compressed together and held between knife edges attached to a specimen. The knife edge configuration depends upon the model type. The Model 632.02 B/C-2X can also be used with the knife edges machined directly into the specimen.



012-215M

Figure 1-1. Model 632.03B-20 Gage
Attached to a Specimen Mounted in Grips

These knife edges support the cantilever arms and serve as the displacement reference points. As the specimen is strained during testing, the cantilever arms move apart with the knife edges. The movement strains the bonded gages, changing their electrical resistance. This results in an unbalanced condition of the Wheatstone bridge circuit and causes an electrical output that is proportional to the cantilever arm displacement.

The Models 632.02-20/-21/-23 Gages are designed specifically to meet ASTM E399 standard fracture mechanics tests. They can also be used in a variety of other applications.

The Models 632.03-20/-21/-23 Gages are also used to perform the ASTM E399 standard fracture mechanics tests. These gages feature improved slot geometry for more accurate measurement and have a larger gage length than the Model 632.02 Gages.

The Models 632.03-30/-31/-33 Gages feature a number of optional gage and travel lengths.

The Models 632.03-50/-51/-53 Gages feature a shorter arm length, specially selected alloys and a side exit for the electrical cable.

The Models 632.05-60/-61/-63 Gages are specifically designed for measurement of crack opening displacements at frequencies as high as 300 Hz. They are built with the MTS patented cross-flexure. They feature a high internal spring force, shortened arms and a top, rear-facing exit for the electrical cable.

The gage length and travel of all models are available in either U.S. customary or SI metric units.

Refer to the specification tables in Subsection 1.2 for additional information on individual models and available options. Refer to Figure 1-2 for the physical dimensions of the individual models.

1.2 Specifications

Tables 1-1 thru 1-6 list the specifications for Models 632.02, 632.03 and 632.05 Gages. Refer to Figure 1-2 for dimensions.

Table 1-1. Models 632.02B/C-2X Specifications

Model ¹	Compressed Gage Length ²	Travel ³	Temperature Range ⁴	Weight ⁵	Standard Cable Length	Max. Frequency (small displacements)
632.02B-20	0.200 in.	+ 0.100 in. - 0.050 in.	- 150°F + 300°F	25 g	22 in. ⁶	50 Hz
632.02B-21	0.200 in.	+ 0.100 in. - 0.050 in.	- 450°F + 150°F	26 g	60 in.	50 Hz
632.02B-23	0.200 in.	+ 0.100 in. - 0.050 in.	- 150°F + 350°F	27 g	60 in.	50 Hz
632.02C-20	5 mm	+ 3 mm - 1 mm	- 100°C + 150°C	25 g	55 cm ⁶	50 Hz
632.02C-21	5 mm	+ 3 mm - 1 mm	- 265°C + 65°C	26 g	1.5 m	50 Hz
632.02C-23	5 mm	+ 3 mm - 1 mm	- 100°C + 175°C	27 g	1.5 m	50 Hz

¹ Models 632.02B are in U.S. customary units. Models 632.02C are in SI metric units. These models may be immersed in most electrically non-conductive fluids used for specimen cooling and heating. Acceptable fluids include moisture-free alcohol, acetone and silicone fluids. Models 632.02B/C-21 may also be immersed in cryogenic fluids such as liquid nitrogen and helium.

² Compressed gage length refers to the distance between the mounted knife edges when the specimen is at rest.

³ Travel refers to the full scale displacement of the arms from the compressed gage length. + refers to tension, - refers to compression.

⁴ Gages may be used 50°F (25°C) higher for short durations (under 24 hours).

⁵ Weight is figured with 8 in. (20 cm) of cable and without the connector.

⁶ Optional 60 in. (1.5m) cable available.

Specifications are subject to change without notice. Contact MTS for specifications critical to your needs.

Table 1-2. Models 632.03B/C-2X Specifications

Model ¹	Compressed Gage Length ²	Travel ³	Temperature Range ⁴	Weight ⁵	Standard Cable Length	Max. Frequency (small displacements)
632.03B-20	0.475 in.	+ 0.150 in.	- 150°F + 300°F	25 g	22 in. ⁶	100 Hz
632.03B-21	0.475 in.	+ 0.150 in.	- 450°F + 150°F	26 g	60 in.	100 Hz
632.03B-23	0.475 in.	+ 0.150 in.	- 150°F + 350°F	27 g	60 in.	100 Hz
632.03C-20	12 mm	+ 4 mm	- 100°C + 150°C	25 g	55 cm ⁶	100 Hz
632.03C-21	12 mm	+ 4 mm	- 265°C + 65°C	26 g	1.5 m	100 Hz
632.03C-23	12 mm	+ 4 mm	- 100°C + 175°C	27 g	1.5 m	100 Hz

¹ Models 632.03B are in U.S. customary units. Models 632.03C are in SI metric units. These models may be immersed in most electrically non-conductive fluids used for specimen cooling and heating. Acceptable fluids include moisture-free alcohol, acetone and silicone fluids. Models 632.03B/C-21 may also be immersed in cryogenic fluids such as liquid nitrogen and helium.

² Compressed gage length refers to the distance between the mounted knife edges when the specimen is at rest.

³ Travel refers to the full scale displacement of the arms from the compressed gage length. Travel is in the + (tension) direction only.

⁴ Gages may be used 50°F (25°C) higher for short durations (under 24 hours).

⁵ Weight is figured with 8 in. (20 cm) of cable and without the connector.

⁶ Optional 60 in. (1.5m) cable available.

Specifications are subject to change without notice. Contact MTS for specifications critical to your needs.

Table 1-3. Models 632.03B/C-3X Specifications

Model ¹	Temperature Range ² Length	Standard Cable	Options 001 to 009	Max. Frequency ⁴ (small displacements)
632.03B-30	– 150°F + 300°F	22 in. ³	See Table 1-4	Varies with unit option
632.03B-31	– 450°F + 150°F	60 in.	See Table 1-4	
632.03B-33	– 150°F + 350°F	60 in.	See Table 1-4	
632.03C-30	– 100°C + 150°C	55 cm ³	See Table 1-4	
632.03C-31	– 265°C + 65°C	1.5 m	See Table 1-4	
632.03C-33	– 100°C + 175°C	1.5 m	See Table 1-4	

¹ Models 632.03B are in U.S. Customary units. Models 632.03C are in SI metric units. These models may be immersed in most electrically non-conductive fluids used for specimen cooling and heating. Acceptable fluids include moisture-free alcohol, acetone and silicone fluids. Models 632.03B/C-31 may also be immersed in cryogenic fluids such as liquid nitrogen and helium.

² Gages may used 50°F (25°C) higher for short durations (under 24 hours).

³ Optional 60 in. (1.5 m) cable available.

⁴ Contact MTS for maximum frequency information.

Specifications are subject to change without notice. Contact MTS for specifications critical to your needs.

Table 1-4. Models 632.03B/C-3X Option Specifications

Option	Compressed Gage Length ¹		Travel ²		Weight ³		
	B-30/-31/-33	C-30/-31/-33	B-30/-31/-33	C-30/-31/-33	B/C-30	B/C-31	B/C-33
001	0.075 in.	2 mm	+ 0.150 in.	+ 4 mm	25 g	26 g	27 g
002	0.100 in.	2.5 mm	+ 0.150 in.	+ 4 mm	25 g	26 g	27 g
003	0.175 in.	4.5 mm	+ 0.150 in.	+ 4 mm	25 g	26 g	27 g
004	0.200 in.	5 mm	+ 0.150 in.	+ 4 mm	25 g	26 g	27 g
005	0.250 in.	6 mm	+ 0.250 in.	+ 6 mm	28 g	29 g	30 g
006	0.250 in.	6 mm	+ 0.500 in.	+ 12 mm	35 g	36 g	37 g
007	0.475 in.	12 mm	+ 0.500 in.	+ 12 mm	35 g	36 g	37 g
008	0.800 in.	20 mm	+ 0.500 in.	+ 12 mm	39 g	41 g	42 g
009	0.500 in.	13 mm	+ 0.500 in.	+ 12 mm	35 g	36 g	37 g
¹ Compressed gage length refers to the distance between the mounted knife edges when the specimen is at rest. ² Travel refers to the full scale displacement of the arms from the compressed gage length. Travel is in the + (tension) direction only. ³ Weight is figured with 8 in. (20 cm) of cable and without the connector.							

Specifications are subject to change without notice. Contact MTS for specifications critical to your needs.

Table 1-5. Models 632.03B/C-5X Specifications

Model ¹	Compressed Gage Length ²	Travel ³	Temperature Range ⁴	Weight ⁵	Standard Cable Length	Max. Frequency (small displacements)
632.03B-50	0.475 in.	+ 0.150 in.	- 150°F + 300°F	30 g	22 in. ⁶	100 Hz
632.03B-51	0.475 in.	+ 0.150 in.	- 450°F + 150°F	30 g	60 in.	100 Hz
632.03B-53	0.475 in.	+ 0.150 in.	- 150°F + 350°F	30 g	60 in.	100 Hz
632.03C-50	12 mm	+ 4 mm	- 100°C + 150°C	30 g	55 cm ⁶	100 Hz
632.03C-51	12 mm	+ 4 mm	- 265°C + 65°C	30 g	1.5 m	100 Hz
632.03C-53	12 mm	+ 4 mm	- 100°C + 175°C	30 g	1.5 m	100 Hz

¹ Models 632.03B are in U.S. customary units. Models 632.03C are in SI metric units. These models may be immersed in most electrically non-conductive fluids used for specimen cooling and heating. Acceptable fluids include moisture-free alcohol, acetone and silicone fluids. Models 632.03B/C-51 may also be immersed in cryogenic fluids such as liquid nitrogen and helium.

² Compressed gage length refers to the distance between the mounted knife edges when the specimen is at rest.

³ Travel refers to the full scale displacement of the arms from the compressed gage length. Travel is in the + (tension) direction only.

⁴ Gages may be used 50°F (25°C) higher for short durations (under 24 hours).

⁵ Weight is figured with 8 in. (20 cm) of cable and without the connector.

⁶ Optional 60 in. (1.5m) cable available.

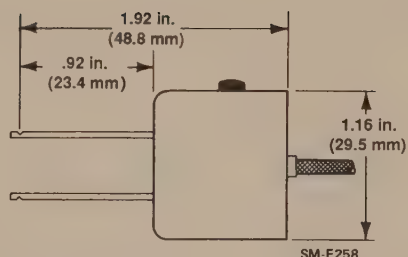
Specifications are subject to change without notice. Contact MTS for specifications critical to your needs.

Table 1-6. Models 632.05B/C-6X Specifications

Model ¹	Compressed Gage Length ²	Travel ³	Temperature Range ⁴	Weight ⁵	Standard Cable Length	Max. Frequency (small displacements)
632.05B-60	1.040 in.	± 0.020 in.	- 150°F + 300°F	25 g	22 in. ⁶	300 Hz
632.05B-61	1.040 in.	± 0.020 in.	- 450°F + 150°F	25 g	60 in.	300 Hz
632.05B-63	1.040 in.	± 0.020 in.	- 150°F + 350°F	33 g	60 in.	300 Hz
632.05C-60	26.4 mm	± 0.5 mm	- 100°C + 150°C	25 g	55 cm ⁶	300 Hz
632.05C-61	26.4 mm	± 0.5 mm	- 265°C + 65°C	25 g	1.5 m	300 Hz
632.05C-63	26.4 mm	± 0.5 mm	- 100°C + 175°C	33 g	1.5 m	300 Hz

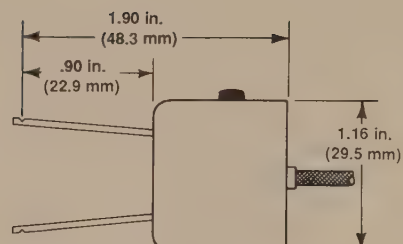
¹ Models 632.05B are in U.S. customary units. Models 632.05C are in SI metric units. These models may be immersed in most electrically non-conductive fluids used for specimen cooling and heating. Acceptable fluids include moisture-free alcohol, acetone and silicone fluids. Models 632.05B/C-61 may also be immersed in cryogenic fluids such as liquid nitrogen and helium.
² Compressed gage length refers to the distance between the mounted knife edges when the specimen is at rest.
³ Travel refers to the full scale displacement of the arms from the compressed gage length.
⁴ Gages may be used 50°F (25°C) higher for short durations (under 24 hours).
⁵ Weight is figured with 8 in. (20 cm) of cable and without the connector.
⁶ Optional 60 in. (1.5m) cable available.

Specifications are subject to change without notice. Contact MTS for specifications critical to your needs.



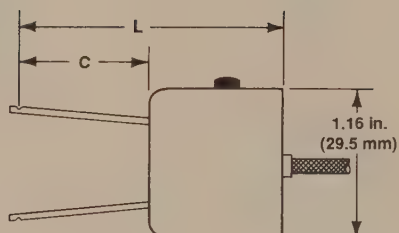
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632.02-2X



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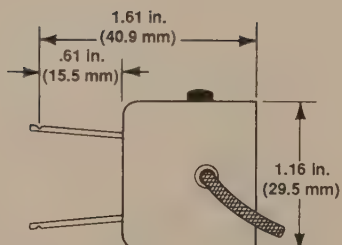
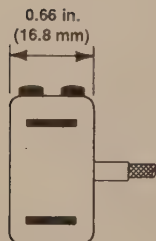
632.03-2X



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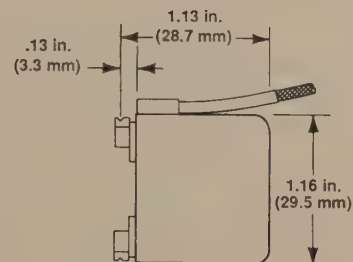
632.03-3X

632.03-3X Option	Dimension L	Dimension C
001	1.90 in. (48.3 mm)	0.90 in. (22.9 mm)
002	1.90 in. (48.3 mm)	0.90 in. (22.9 mm)
003	1.90 in. (48.3 mm)	0.90 in. (22.9 mm)
004	1.90 in. (48.3 mm)	0.90 in. (22.9 mm)
005	2.41 in. (61.2 mm)	1.41 in. (35.8 mm)
006	3.49 in. (88.6 mm)	2.49 in. (63.2 mm)
007	3.49 in. (88.6 mm)	2.49 in. (63.2 mm)
008	3.52 in. (89.4 mm)	2.27 in. (57.7 mm)
009	3.49 in. (88.6 mm)	2.49 in. (63.2 mm)



SM-F258-2

632.03-5X



SM-F258-3

632.05-6X

Figure 1-2. Dimensions of Model 632.02/.03/.05 Gages

Table 1-6. Models 632.05B/C-6X Specifications

Model ¹	Compressed Gage Length ²	Travel ³	Temperature Range ⁴	Weight ⁵	Standard Cable Length	Max. Frequency (small displacements)
632.05B-60	1.040 in.	± 0.020 in.	- 150°F + 300°F	25 g	22 in. ⁶	300 Hz
632.05B-61	1.040 in.	± 0.020 in.	- 450°F + 150°F	25 g	60 in.	300 Hz
632.05B-63	1.040 in.	± 0.020 in.	- 150°F + 350°F	33 g	60 in.	300 Hz
632.05C-60	26.4 mm	± 0.5 mm	- 100°C + 150°C	25 g	55 cm ⁶	300 Hz
632.05C-61	26.4 mm	± 0.5 mm	- 265°C + 65°C	25 g	1.5 m	300 Hz
632.05C-63	26.4 mm	± 0.5 mm	- 100°C + 175°C	33 g	1.5 m	300 Hz

¹ Models 632.05B are in U.S. customary units. Models 632.05C are in SI metric units. These models may be immersed in most electrically non-conductive fluids used for specimen cooling and heating. Acceptable fluids include moisture-free alcohol, acetone and silicone fluids. Models 632.05B/C-61 may also be immersed in cryogenic fluids such as liquid nitrogen and helium.

² Compressed gage length refers to the distance between the mounted knife edges when the specimen is at rest.

³ Travel refers to the full scale displacement of the arms from the compressed gage length.

⁴ Gages may be used 50°F (25°C) higher for short durations (under 24 hours).

⁵ Weight is figured with 8 in. (20 cm) of cable and without the connector.

⁶ Optional 60 in. (1.5m) cable available.

Specifications are subject to change without notice. Contact MTS for specifications critical to your needs.

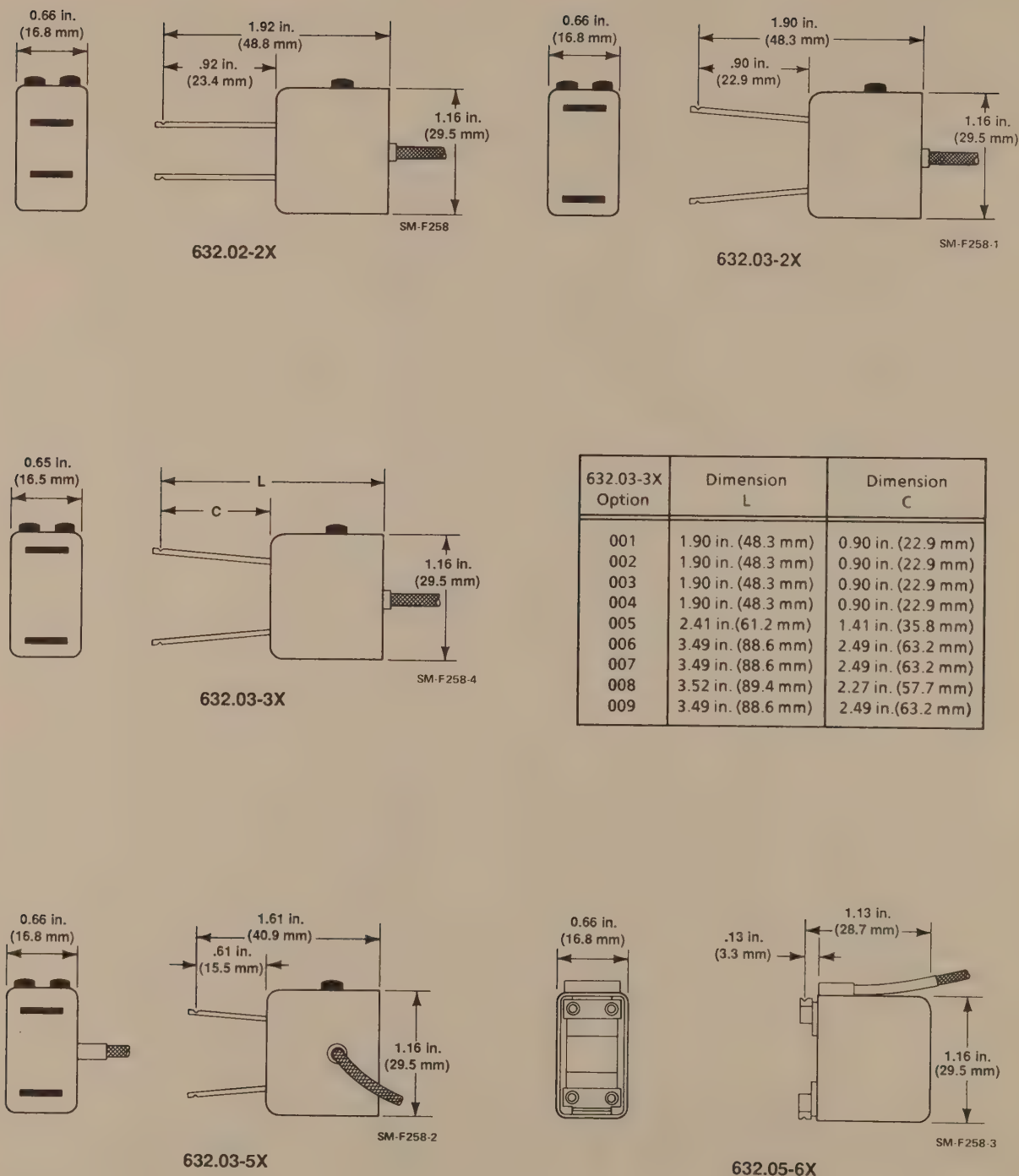


Figure 1-2. Dimensions of Model 632.02/.03/.05 Gages

Section II Operation

Operation of the Models 632.02/.03/.05 Clip-On Displacement Gages consists of adjusting the dc controller or dc conditioner for a zero percent of full scale offset. This procedure assumes that the Gage has been properly mounted on the specimen and cabled to the system controller or conditioner as described in Section IV of this manual.

The electrical output of the Gage must be adjusted so that zero strain equals zero volts output. Zero adjustment is performed at the dc controller or dc conditioner to which the Gage is connected. To zero the dc controller or dc conditioner output, turn the Zero Adjust (or Zero) control until the readout indicates a zero percent full scale reading. (Refer to the appropriate dc controller or dc conditioner product manual for specific operating information.)

CAUTION

Over-compression of a Clip-On Displacement Gage will damage the unit. Adjust the lower limit detector of the conditioning electronics to minimize the possibility of over-compressing the Gage. Refer to the appropriate specification table (Tables 1-1 through 1-6) for the maximum - travel. (Refer to the appropriate dc controller or dc conditioner product manual for the limit detector adjustment procedure.)

Section III Calibration

Clip-On Displacement Gage calibration is accomplished by adjustments contained in the associated conditioning electronics. In an MTS system this typically consists of a dc controller and one or more range cartridges or a dc conditioner and a range card. Gages should be calibrated with the associated conditioning electronics with which they will be used.

Clip-On Displacement Gages used with MTS conditioning electronics have pre-calibrated range cartridges/range cards available. The range cartridge/range card provides compensation circuitry for an improved match between the Gage and the conditioning electronics. The Gage model number and serial number is recorded on the range cartridge/range card for matching identification. Initial calibration of a pre-calibrated range cartridge/range card is performed at the factory. If the range cartridge/range card is pre-calibrated while installed in the particular dc controller or dc conditioner which will be used with the Gage during actual testing applications, it is not required that the user perform any initial calibration adjustments. A single dc controller or dc conditioner can be used with a number of Gages, without recalibrating, by installing the range cartridge/range card matched to the selected Gage. Refer to the appropriate dc controller or dc conditioner product manual for further calibration information.

3.1 Calibration Check (Shunt Calibration)

A calibration check should be performed periodically to determine if calibration accuracy of the Gage in conjunction with the range cartridge or range card is being maintained.

Each Gage that is shipped with a matching range cartridge(s) or range card has the following associated calibration paperwork included: Report of extensometer calibration and Clip-On Displacement Gage inspection certificate. A pamphlet explaining the theory and use of shunt calibration is also supplied.

Shunt calibration allows a given Gage and range cartridge(s) or range card to be used with various dc controllers or dc conditioners (of the same model number) without Gage/conditioning electronics recalibration.

CAUTION

Ensure hydraulic power is off before performing the following procedure to prevent stressing the specimen or Gage.

Perform the following procedure to check the calibration of an associated Gage and range cartridge or range card. The following procedure assumes that:

- The Gage is properly installed on a specimen (between the knife edges at zero displacement and connected to the system electronics) as described in the Installation section of this manual.
- The model number and serial number on the Gage (the serial number is located on the back of the Gage) matches that specified on the selected range cartridge/card.
- The selected range cartridge/card is installed in the dc controller or dc conditioner.

All controls referred to in the following procedure are located on the front panel of the dc controller or dc conditioner. Refer to the appropriate dc controller or dc conditioner product manual for specific information regarding these controls.

1. Apply electrical power to the console (power was removed if a range card was installed). Range selection must be made for dc conditioners.
2. Ensure that the Gage is not selected for the active control mode.
3. Select the dc controller or dc conditioner output for readout.
4. Adjust the zero control to remove any offset present.
5. Press the Shunt Cal switch and note the readout voltage (offset).
6. Compare the readout voltage (offset) noted in step 5 with the shunt calibration voltage offset recorded on the report of extensometer calibration supplied with the Gage. Record any difference between the actual reading (noted in step 5) and the recorded voltage offset (recorded on the report).
7. If the difference recorded in step 6 is greater than 0.1% of full scale (typically 10 Vdc) but less than 0.5%, the transducer excitation must be adjusted. Press the Shunt Cal switch and adjust the excitation control on the range cartridge or range card to achieve the recorded shunt cal offset within $\pm 0.01\%$. If the difference recorded in step 6 is greater than 0.5% of full scale, perform the calibration procedures beginning with Subsection 3.2.

3.2 Required Calibration Equipment

Required equipment includes a Model 650.03 Calibrator equipped with the 1A and 2A knife edge holders. The Model 650.03B micrometer head is graduated in U.S. customary units, the Model 650.03C micrometer head is graduated in SI metric units. See Figure 3-1 for a Gage mounted on a 650.03B Calibrator. If a calibrator is not available, the Gage and associated range cartridge(s) or range card will have to be returned to MTS Systems Corporation for calibration.

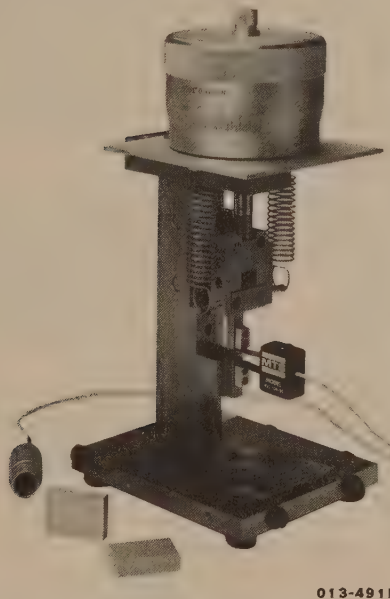


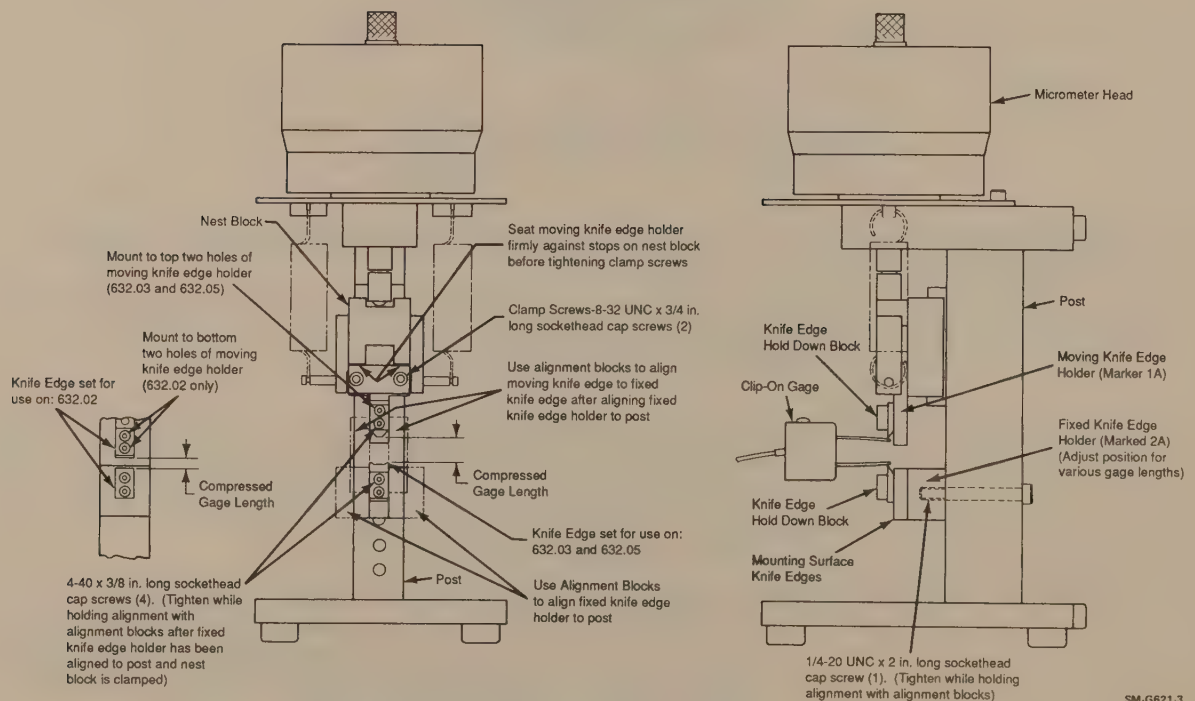
Figure 3-1. Clip-On Displacement Gage Shown Mounted on a Model 650.03B Calibrator

3.3 Setting Up the Calibrator for Clip-On Displacement Gage Calibration

Perform the following procedure to prepare the Calibrator for mounting the Gage for displacement calibration. Refer to Figure 3-2 during the following procedure.

1. Loosely attach the appropriate knife edges and knife edge hold down blocks to the moving knife edge holder (marked 1A) and the fixed knife edge holder (marked 2A) using a hex wrench. Refer to Figure 3-2 for proper knife edge configuration and knife edge attachment.
2. Loosely attach the fixed knife edge holder (marked 2A) to the calibrator post. Use an appropriate hole in the post approximating the compressed gage length and travel of the Gage. Refer to the Section I specifications tables for the compressed gage length and travel of the Gages.

3. Position and hold the two alignment blocks tightly against the left and right sides of the calibrator post and the fixed knife edge holder to ensure the fixed edge knife holder is perfectly aligned to the calibrator post. Hold this alignment and tighten the sockethead cap screw using a hex wrench.
4. Seat the moving knife edge holder (marked 1A) firmly against the stops on the nest block and tighten the clamp screws using a hex wrench.
5. Position and hold the two alignment blocks tightly against the left and right sides of the moving knife edge and the fixed knife edge, to align the knife edge set. The micrometer head may have to be adjusted to decrease the distance between the moving and fixed knife edges. Hold this alignment and tighten the knife edge sockethead cap screws.
6. Use the knife edge alignment fixture that was supplied with the Gage to establish the correct compressed gage length. Adjust the micrometer head for this precise compressed gage length, representing zero displacement (zero reference). Record the micrometer reading.
7. Refer to Figure 4-1, 4-2 or 4-3 (depending on model number) in Section IV of this manual for instructions on attaching the Gage between the knife edges.



SM-G621-3

Figure 3-2. Clip-On Displacement Gage/Calibrator Drawing

3.4 Clip-On Displacement Gage Calibration Procedure

The purpose of calibrating a range cartridge or range card is to ensure the dc controller or dc conditioner accurately reflects the Gage response. Each range cartridge is calibrated to a specific Gage for a specific gain range. Each range card is calibrated to a specific gage for four gain ranges. Proper calibration requires that the Gage be properly mounted on the calibrator, the excitation, gain and nonsymmetry (ΔK) circuitry be adjusted. (ΔK compensates for a difference in sensitivity of a Gage between tension and compression).

NOTE

Each range cartridge calibrates a single range and contains an excitation, a ΔK and a gain adjustment. A range card calibrates four ranges with a single excitation, a single ΔK and an individual gain adjustment for each range.

NOTE

Gages that operate solely in tension do not use the ΔK adjustment. If the Gage being calibrated with a designated range cartridge or range card is tension only, its designated range cartridge or range card will have the ΔK circuit disabled (the ΔK adjustment potentiometer and/or the ΔK diode will have been removed).

The following procedure assumes that:

- The Gage has a designated range cartridge or range card and is mounted on a properly set-up calibrator, as directed in Subsection 3.3. If calibration is being performed on an undesignated range cartridge or range card, refer to the appropriate dc controller or dc conditioner product manual for information on gain resistor selection and additional procedures.
- The associated range cartridge on range card is installed in the dc controller or dc conditioner.
- The Gage is at zero displacement. Compare the reading on the micrometer with that recorded in step 6 of Subsection 3.3. This reading is the zero displacement (zero reference) reading.

Refer to Figures 3-1 and 3-2 for examples of calibration data for a typical 632.02B-20.

1. If calibrating a range card, select the range on which optimum accuracy is required (when performing the excitation and (if applicable) the ΔK adjustments. All ranges can be optimized when using range cartridges.
2. Monitor the conditioner output and adjust the zero control at either the dc controller, dc conditioner (or on the test controller front panel) to 0.000 Vdc.

NOTE

If adjusting a Gage that has displacement in tension only proceed with step 3. If adjusting a Gage that has displacement in tension and compression proceed with step 13.

CAUTION

Over-compression of a Clip-On Displacement Gage will damage the unit.

3. Remove any hysteresis by cycling the micrometer head between the zero reference and the displacement equivalent to +100% of travel for the selected range in tension three times, ending at the zero reference, then readjust the conditioner output to 0.000 Vdc by adjusting the zero control.
4. Adjust the micrometer head of the calibrator to a displacement equivalent to +80% of travel for the selected range in tension.
5. Turn the gain potentiometer on the range cartridge or the gain potentiometer for the selected range on the range card to mid-range.
6. Monitor the output of the conditioner and adjust the excitation potentiometer on the range cartridge or range card for 8.000 Vdc.
7. Monitor the excitation voltage. Adjust the excitation potentiometer for excitation voltage to the nearest 0.5 Vdc.
8. Monitor the output of the conditioner and adjust the gain potentiometer on the range cartridge or the gain potentiometer for the selected range on the range card for 8.000 Vdc.
9. Adjust the micrometer head to the zero reference.
10. Readjust the conditioner output of the for 0.000 Vdc by adjusting the zero control.

11. Readjust the micrometer head for a displacement equivalent to +80% of the selected range in tension.
12. If necessary, readjust the gain potentiometer on the range cartridge or the gain potentiometer for the selected range on the range card for 8.000 Vdc of conditioned output. If gain was readjusted, repeat this procedure beginning with step 7 until 8.000 Vdc is obtained without having to readjust gain, then proceed to step 30.

CAUTION

Over-compression of a Clip-On Displacement Gage will damage the unit.

13. Remove and hysteresis by cycling the micrometer head between the zero reference and the displacement equivalent to -100% of travel for the selected range in compression three times, ending at the zero reference, then readjust the conditioner output to 0.000 Vdc.
14. Adjust the micrometer head of the calibrator to a displacement equivalent to -80% of travel for the selected range in compression.
15. Turn the gain potentiometer on the range cartridge or the gain potentiometer for the selected range on the range card to mid-range.
16. Monitor the conditioner output and adjust the excitation potentiometer on the range cartridge or range card for 8.000 Vdc.
17. Monitor the excitation voltage. Adjust the excitation potentiometer for excitation voltage to the nearest 0.5 Vdc.
18. Monitor the output conditioner and adjust the gain potentiometer on the range cartridge or the gain potentiometer for the selected range on the range card for 8.000 Vdc.
19. Readjust the micrometer head to the zero reference.
20. Readjust the conditioner output for 0.000 Vdc by adjusting the zero control.
21. Readjust the micrometer head for displacement equivalent to 80% of travel for the selected range in compression.

22. If necessary, readjust the gain potentiometer on the range cartridge or gain potentiometer for the selected range on the range card for 8.000 Vdc. If gain was readjusted, repeat this procedure beginning at step 16 until 8.000 Vdc is obtained without having to readjust gain, then proceed to the next step.
23. Remove any hysteresis by cycling the micrometer head between the zero reference and the displacement equivalent to +100% of travel for the selected range in tension three times, ending at the zero reference, then re-zero the conditioner output to 0.000 Vdc.
24. Adjust the micrometer head for a displacement equivalent to +80% of travel for the selected range in tension.
25. Adjust the ΔK potentiometer on the range cartridge or range card for 8.000 Vdc.
26. Return the micrometer head to the zero reference.
27. Readjust the conditioner output for 0.000 Vdc by adjusting the zero control.
28. Repeat steps 24 thru 27 until the 8.000 Vdc requirement is met, without having to readjust ΔK , then proceed to the next step.

CAUTION

When performing step 29 in the 100% of full scale range on a Model 632.02 B/C do not exceed the maximum compression displacement specification of the Gage. damage to the Gage can occur.

29. To verify the linearity, adjust the micrometer head in 20% displacement increments (data points 0, -20, -40, -60, -80, -100) in compression. Record the output voltage for each increment for future reference.
30. To verify the linearity, adjust the micrometer head in 20% displacement increments (data points 0, +20, +40, +60, +80, +100) in tension. Record the output voltage for each increment for future reference.
31. Return the micrometer head to zero displacement (zero reference reading).
32. Adjust the zero control to remove any offset.

33. Press the Shunt Cal button. Record the new shunt cal reading. This new reading will be used for reference during future calibration checks.

Table 3-1. Example of 632.02B-20 Calibration Data

Gain Range (% of Full Scale)	Maximum Travel		Micrometer Offset From Zero Ref.		Output Voltage	
	Tension	Compression	Tension	Compression	Tension	Compression
100	+ 0.100 in.	- 0.050 in.	+ 0.080 in.	- 0.050 in. ¹	+ 8.000	- 5.000 ¹
50	+ 0.050 in.	- 0.050 in.	+ 0.040 in.	- 0.040 in.	+ 8.000	- 8.000
20	+ 0.020 in.	- 0.020 in.	+ 0.016 in.	- 0.016 in.	+ 8.000	- 8.000
10	+ 0.010 in.	- 0.010 in.	+ 0.008 in.	- 0.008 in.	+ 8.000	- 8.000

¹ Micrometer offset and output voltage in compression are limited by the smaller maximum Gage travel specifications.

Table 3-2. Example of 632.02B-20 Linearity Data Points

Gain Range (% of Full Scale)	Data Points (% of Full Scale)		Micrometer Offset from Zero Ref.		Output Voltage	
	Tension	Compression	Tension	Compression	Tension	Compression
100	+ 20	- 20	+ 0.020 in.	- 0.020 in.	+ 2.000	- 2.000
	+ 40	- 40	+ 0.040 in.	- 0.040 in.	+ 4.000	- 4.000
	+ 60	-	+ 0.060 in.	- ¹	+ 6.000	- ¹
	+ 80	-	+ 0.080 in.	-	+ 8.000	-
	+ 100	-	+ 0.100 in.	-	+ 10.000	-
50	+ 20	- 20	+ 0.010 in.	- 0.010 in.	+ 2.000	- 2.000
	+ 40	- 40	+ 0.020 in.	- 0.020 in.	+ 4.000	- 4.000
	+ 60	- 60	+ 0.030 in.	- 0.030 in.	+ 6.000	- 6.000
	+ 80	- 80	+ 0.040 in.	- 0.040 in.	+ 8.000	- 8.000
	+ 100	- 100	+ 0.050 in.	- 0.050 in.	+ 10.000	- 10.000
20	+ 20	- 20	+ 0.004 in.	- 0.004 in.	+ 2.000	- 2.000
	+ 40	- 40	+ 0.008 in.	- 0.008 in.	+ 4.000	- 4.000
	+ 60	- 60	+ 0.012 in.	- 0.012 in.	+ 8.000	- 6.000
	+ 80	- 80	+ 0.016 in.	- 0.016 in.	+ 8.000	- 8.000
	+ 100	- 100	+ 0.020 in.	- 0.020 in.	+ 10.000	- 10.000
10	+ 20	- 20	+ 0.002 in.	- 0.002 in.	+ 2.000	- 2.000
	+ 40	- 40	+ 0.004 in.	- 0.004 in.	+ 4.000	- 4.000
	+ 60	- 60	+ 0.006 in.	- 0.006 in.	+ 6.000	- 6.000
	+ 80	- 80	+ 0.008 in.	- 0.008 in.	+ 8.000	- 8.000
	+ 100	- 100	+ 0.010 in.	- 0.010 in.	+ 10.000	- 10.000

¹ Micrometer offset and output voltage in compression are limited by the smaller maximum Gage travel specifications.

Section IV Installation

Installation of the Models 632.02/.03/.05 Clip-On Displacement Gages consists of attaching the Gage to a prepared specimen and connecting the Gage electrical cable to the dc conditioning electronics (dc controller or dc conditioner). All models include a foam padded case containing the Gage, mating connector, knife edge set, connector holder, knife edge alignment fixture, sockethead cap screws for attaching the knife edges, hex wrench for the sockethead cap screws and three documents: an inspection certificate, a gage installation drawing and a connector holder installation drawing. Two additional documents, a report of extensometer calibration and a shunt calibration pamphlet are also included when the Gage ships with a matching range cartridge(s) or range card.

4.1 Attachment to a Specimen

The specimen must be prepared to accept the Gage. The parts and tools supplied with the Gage are used to facilitate attachment. Refer to Figure 4-1, 4-2 or 4-3 (depending on model number) to prepare the specimen for fracture mechanics testing.

1. If applicable, machine the crack-starter notch and drill the grip attachment holes.

NOTE

The Models 632.03 and 632.05 Gages are not intended for use on a specimen with knife edges machined into the specimen. Knife edges supplied with the Model 632.02 cannot be used with Models 632.03 or 632.05.

2. Attach the knife edges to the specimen using the sockethead cap screws. Use the knife edge alignment fixture to establish the gage length and knife edge alignment.

CAUTION

Over-compression of a Clip-On Displacement Gage will damage the unit.

3. Attach the Gage.

NOTE

If a Model 632.02B/C-2X Gage is being used and the specimen is very thin (less than 0.16 in. or 4.0 mm), the knife edges should be machined directly into the specimen. Refer to Figures 4-1 and 4-4.

Connector: Amphenol 165-15-1002
(Bridge completion circuitry inside - do not disassemble or remove from cable.)
Mating Connector: Amphenol 165-14)

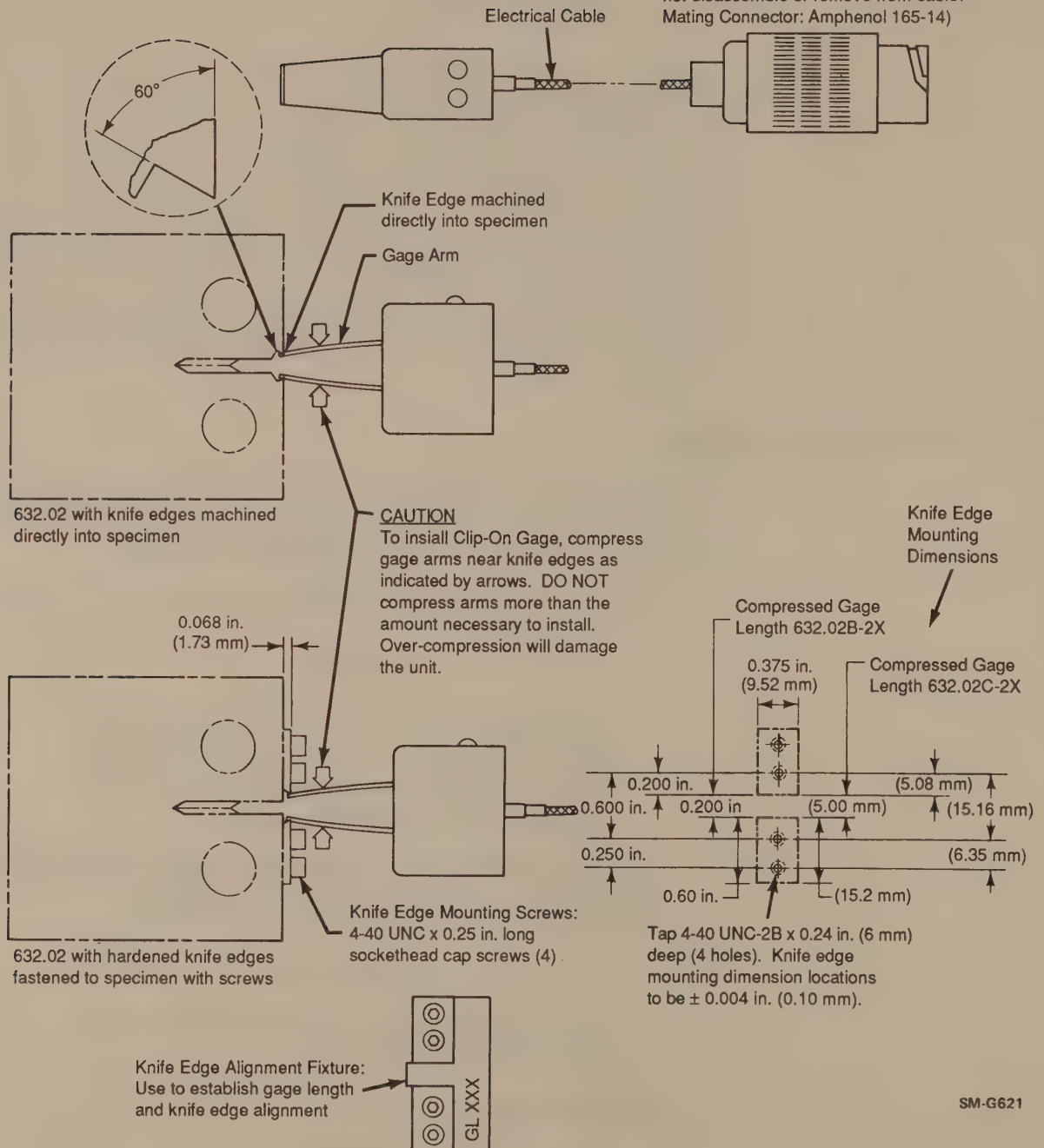


Figure 4-1. Models 632.02B/C-2X Attachment Specifications and Instructions

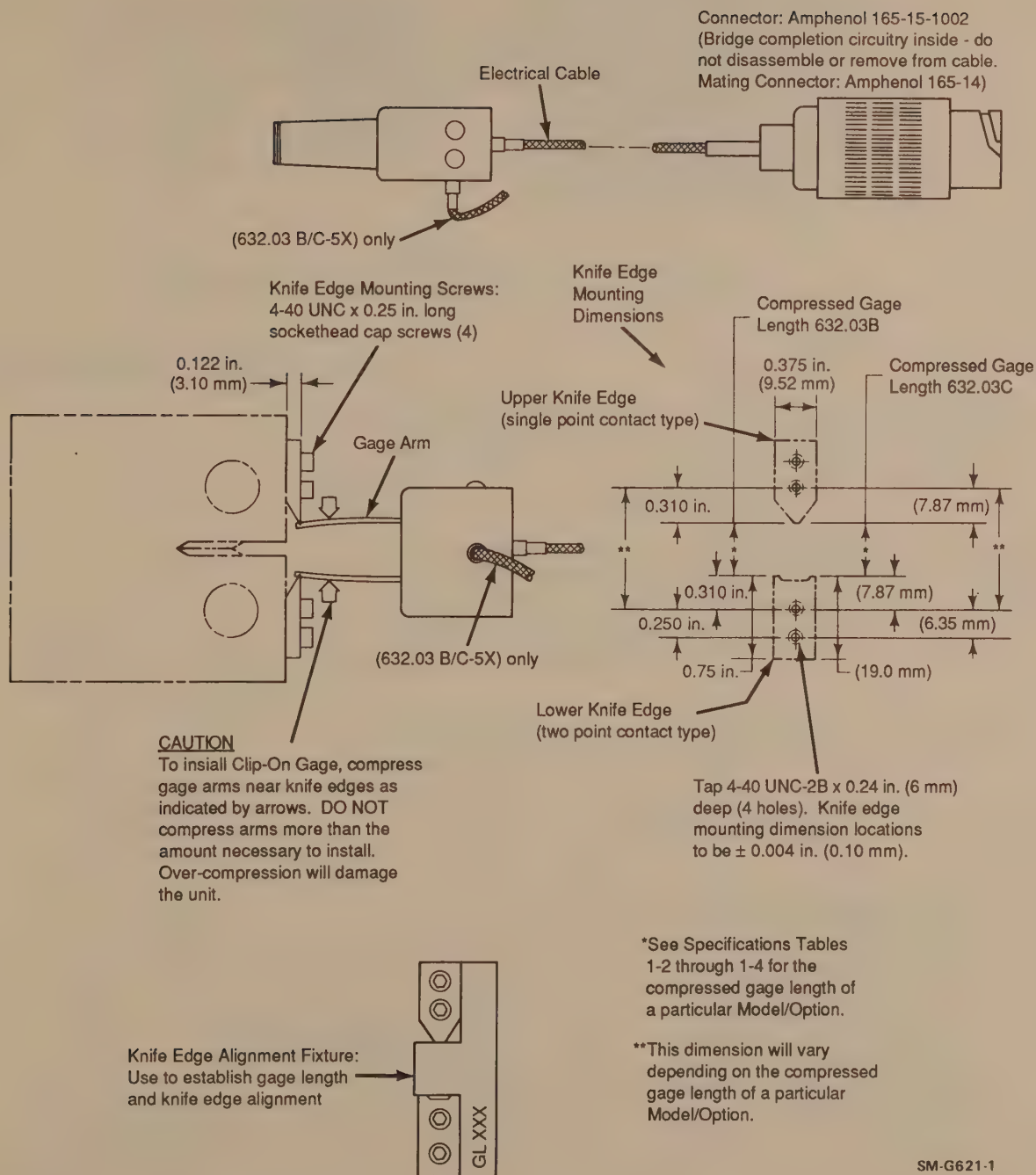


Figure 4-2. Models 632.03B/C-2X/-3X/-5X Attachment Specifications and Instructions

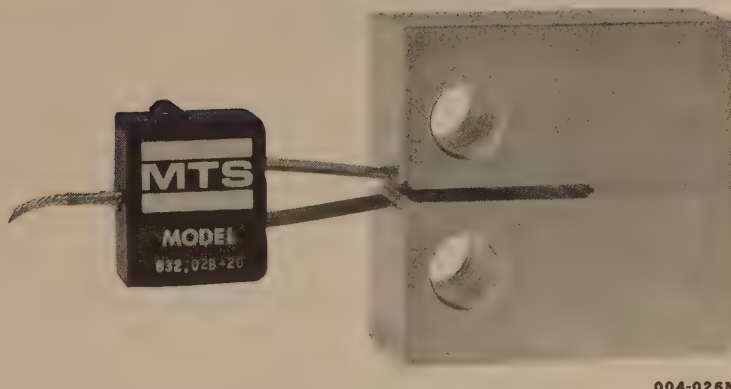


Figure 4-4. Model 632.02B-20 Shown with Knife Edges Machined into the Specimen

4.2 Connection to the System

1. Connect the Gage connector to the mating connector on the cable going to the system control electronics. Refer to Figure 4-5 for a drawing of the Gage bridge circuit and connector.
2. Once the Gage is properly attached to the specimen and the electrical connection has been made, the output of the Gage must be adjusted to zero. This is performed at the associated conditioning electronics. Refer to Section II, Operation, for further information.

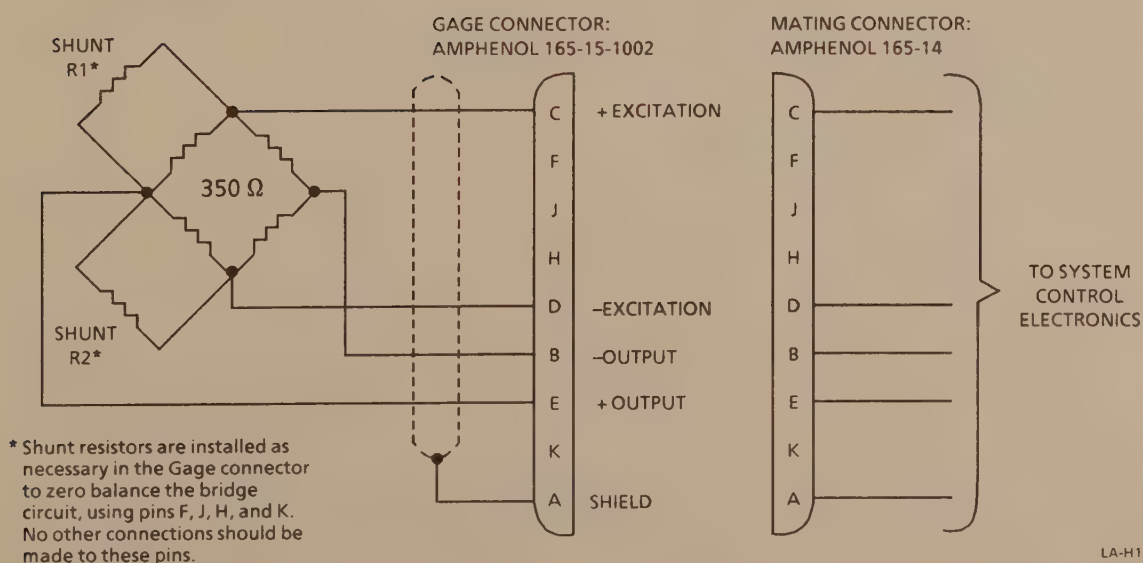


Figure 4-5. Bridge Circuit and Connector

PRODUCT MANUAL COMMENT SHEET

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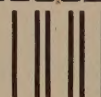
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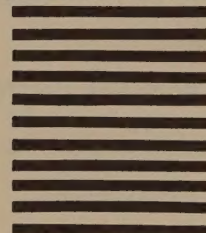
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